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SOIL CONSERVATION

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SOIL CONSERVATION IN THE NAVAJO COUNTRY

By Charles W. Collier

For many years the American Southwest was pictured as a land of mining towns, mountains, and cactus-bearing deserts. Writers told of high adventure and of a continuous struggle to maintain law and order. Motion pictures added to the illusion with romantic stories of highwaymen and cowboys. Gradually in popular conception, the Southwest came to be regarded as a territory apart, where frontier mode was the rule rather than the exception.

Behind this exaggerated representation of life in the Southwest is a real story, more accurate, less fanciful, withal colorful. In the area now comprising the States of New Mexico and Arizona, great civilizations once lived and flourished. The evidence points to the existence of a highly scientific agriculture, accompanied by an advanced social culture.

Wooded mountain ranges and hills alternated with broad valleys of deep, rich soil, covered with an abundance of grasses, herbs, and grazing plants. Wild hay was there for the cutting. On the hills were great forests of pinon, juniper, and pine. Streams were lined with willows, cottonwoods, and other trees.

This was the Navajo country of a few centuries ago. This was the land the Spaniards found in their American explorations.

As It Is Now

Since 1867 the Navajo population has increased from about 8,000 to approximately 45,000, and from a few scattered herds of sheep the country is now attempting to support more than a million head of sheep and goats, plus considerable numbers of cattle and horses.

As the human and livestock populations grew, the blanket-weaving and wool-marketing activities of the people assumed proportions of a sizeable industry. In this the Navajos were encouraged by their white advisors, who had faith in the unfailing productivity of the land. But grass grew less and less vigorous, and the stand became more and more sparse. Soon gullies began to form around the too infrequent water holes and springs.

Once started, the erosion process proceeded rapidly. The Oraibi wash is a typical example. Once a mild, narrow, and shallow stream, lined with small but productive cornfields, it has become an ugly, twisting gully

Typical panorama in the overgrazed country of the Southwest.

for its entire length of 80 miles, varying from 20 to 80 feet in depth. All of its tributaries are in a similar condition, adding to the destruction of farm lands and helping to carry enormous quantities of silt into the Colorado River.

Overgrazing, the almost universal enemy of the Southwest, is responsible for the accelerated erosion typified by the Oraibi wash. Too many grazing animals, either concentrated in a small space or spread over a large area, reduce the normal stand of grass, weeds, and shrubs, and allow an unrestricted flow of water over the hillsides. Broad, grassy swales become networks of tiny gullies eating cancerlike in every direction and combining, in their downward paths, to form giant ravines, sapping the water formerly available for plant growth and destroying the power of even the richest soil to produce worthwhile vegetation.

Irrigation Becomes Impossible

That is what happened to the Navajo country. Cornfields and squash patches, formerly irrigated by simple methods of flood-water farming, are now neglected because the water courses have become wild and uncontrollable. Slopes and valleys that once produced abundant forage are now given over to worthless weeds and bare ground. The grazing cover has been destroyed to a large degree. The pinon, that valuable nut bearer whose great crops were one of the Navajos' chief income producers, is gradually disappearing because the goats destroy the seedlings and the mature trees are being consumed for fuel.

Recurrent droughts, which once held no terror for the Navajo, now deprive him of income and hasten depletion of the land. Where antelope, deer, and wild turkey were once abundant, overgrazing and unlimited hunting have depleted the stock. Reservoirs are being filled with silt and erosion debris, jeopardizing the effectiveness of irrigation systems.

Accelerated erosion is proceeding so rapidly, to the detriment of grazing, agriculture, forests, and irrigation works, as to threaten the existence of the Navajo people and the future of the entire region. The remedy lies in more careful use of the land, in the up-

Erosion's workings in the Southwest.

building and maintenance of proper soil conditions through the use of vegetation and grazing control, and in a general social readjustment to keep pace with the process of rehabilitation.

Help for the Indian

On an area of 17,000,000 acres in New Mexico and Arizona, including all of the Navajo, Hopi, and Zuni Reservations, extensive erosion-control activities have been started by the Soil Conservation Service.

The general objectives of the project are to conserve the remaining lands of the area by (1) checking destructive erosion and conserving the water supply, (2) regulating the use of forage and forest cover, (3) promoting the best practices of agriculture, forestry, and other phases of land use and, in cooperation with the Indian Service, integrating land use with the other arts, occupations, and problems of the Navajo people. The fourth broad objective is to furnish the Indians with profitable employment and useful training in land management insofar as is consistent with the national soil conservation program.

The problem is not a simple one of gully plugging. Its solution demands a combined effort of governmental agencies toward the economic and social rehabilitation of a great Indian nation, involving the right kind of education and the realinement of agricultural and grazing activity on an enduring basis. It has been necessary to convince the Navajo people that the situation is serious and that they must make a sacrifice to save their lands.

The first important step in the program has been the preparation of comprehensive range surveys upon which to determine suitable carrying capacities and

Exposed roots of yellow pine on rock slope. These roots could not have grown on bare rock—hence, the trees must antedate the denudation.

range-management plans. Parallel to the making of these surveys has gone a general reduction in number of livestock. With the completion of detailed range-management plans, the reservation will be divided into

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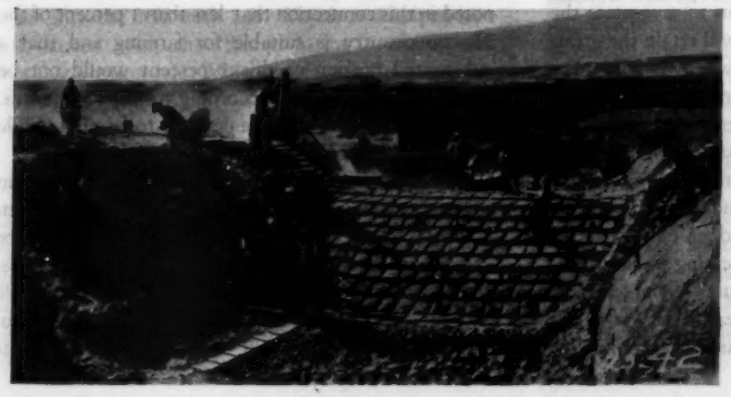

Laying asphalted bags on spillway. Note shingling; also, pipes for relieving water pressure. Freeman flats, Graham County, Ariz.

ACTIVITIES TO BE CORRELATED

Dillon S. Myer is announced as Chief of the important Division of Cooperative Relations and Planning. His triple responsibilities, as such, include cooperative relations in extension, cooperative relations in planning, and information.

In the report of the Secretary's committee on soil conservation, approved by the Secretary on June 6, recognition was given to the necessity of cooperation and correlation of State and Federal activities pertaining to the control of erosion and the safeguarding of the Nation's soils.

At the outset Mr. Myer will devote special attention to the development of proper working relationship between agricultural colleges, experiment stations, extension services, and the Soil Conservation Service in each State, and between the Service and the Agricultural Adjustment Administration, the Tennessee Valley Authority, the Resettlement Administration, the various bureaus of the Department of the Interior, and other Government agencies involved in the soil conservation program. The head of division will also have charge of informational activities and the working out of long-time plans for a progressive national program of soil conservation.

Mr. Myer comes to the Service ideally equipped for his large task. He received his B. S. degree in agriculture from the Ohio State University in 1914, and his M. A. degree in education from Columbia University in 1926. From 1914 to 1916 he was an assistant in farm crops at the Kentucky Agricultural Experiment Station and instructor in agronomy at the Kentucky Agricultural College. From 1916 to 1920 he was with Purdue University, engaged in extension work. From 1920 to 1922 he was county agent of Franklin County, Ohio. From 1922 to 1933 he was district supervisor of extension, Ohio State University.

Since 1933 Mr. Myer has been connected with the Agricultural Adjustment Administration, first as State agent in extension work, then as Chief of the Compliance Section, and more recently as Assistant Director of the Division of Program Planning.

Upon assuming his new post, Mr. Myer set forth on a 3-week tour of inspection and conference, to familiarize himself with conditions in the field. Part of this trip he made in company with the Chief of the Service, H. H. Bennett.

In introducing his appointee, Mr. Bennett bespeaks the hearty cooperation of every member of the staff.

SOIL CONSERVATION IN THE NAVAJO COUNTRY

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natural range units within which the Indians will be organized to carry the plans into effect.

Aside from restoring natural vegetation through range management, the Service aims to revegetate the ranges by such artificial means as will retain the greatest practicable amount of water where it falls. For this purpose, water is being diverted out of gullies, around gully heads, and spread over the flat and gently sloping ground to increase the natural growth of grass and other plants. Gullies that are too big for such treatment are being planted to quick-growing cottonwoods, willows, and tamarisks and, as rapidly as the stock can be produced, to food bearing trees such as wild plum, walnut, and honey locust. Denuded spots are being planted or sown to a great variety of native plants that are valuable for forage as well as for holding the soil.

Water diverted from gullies is being made available to the Indians, to the greatest extent possible, for the flood-irrigation of agricultural lands. It should be noted in this connection that less than 1 percent of the Navajo country is suitable for farming and that a substantial portion of this 1 percent would not be considered as farm land according to usual standards. In all, only 50,000 acres are devoted to farming, while the remainder is in range.

Much work remains to be done. The enthusiasm and cooperation of the Navajos, however, has been heartening, and since the work of restoration must be carried to a conclusion by the Navajos themselves, the partnership now being formed between the people and the agencies of Government is a most hopeful sign that the project will ultimately accomplish its objectives.

LABOR ADVANTAGES OF CONTOUR LISTING

By R. L. von Trebra

Regional Director, Albion, Nebr.

Many farmers signing cooperative agreements for an erosion control program were very skeptical as to the value of terraces and contour cultivation. Some of them jokingly referred to it as "tango listing."

Mike Wojcik was one of these skeptical farmers. His farm consisted of 306 acres of rough hilly land. The cooperative agreement called for the control of gullies, the retirement of some of the farm from cultivation, seeding to permanent pasture grasses and alfalfa and the construction of a system of terraces. On the terraced land contour cultivation and contour cropping was to be followed.

Horses Weak for Spring Work

Due to the severe drought of last summer, Mr. Wojcik, as well as many other farmers in the drought area, failed to raise enough feed for his livestock. His work horses had to subsist on the little roughness that was grown on the farm. At times they received a small portion of grain as a dessert. Mr. Wojcik's horses were in poor condition for spring work. Expressed in his own words, when he needed a two-horse team, it was necessary to hitch four horses together in order that the outside horses might hold up the middle team.

When corn planting time came around, Mr. Wojcik wondered what to do and how to contour list his terraced fields. R. R. Hinde, the agronomist who had worked out the erosion control plan for the farm, went into the field with Mr. Wojcik and helped him get started with the "tango listing." After the first day's listing Mr. Wojcik was "sold" on contour cultivation or working on the level.

Kept Operations on Level

He stated that his weakened horses could not have pulled a lister up the steep hills. By working his farm on the contour, his operations were kept on the level. He used four horses on a two-row lister and due to the fact that working was made easier, the horses were able to stand up under the strain of spring work.

Mr. Wojcik's experiences are similar to those of many others. Working rough land on the level has meant a saving of approximately 20 percent of the ordinary fuel consumption of tractors. They may be kept in high gear instead of second and low gear as was formerly necessary when pulling up and down hill.

His foot is on top of post set in 1926.

BERMUDA STRIP CATCHES SOIL

William Lloyd Neill, Arkansas farmer, finds Bermuda useful as a vegetative turfing grass for erosion control. He calls attention to a strip of pasture bordering his meadow that has controlled run-off from slopes in his unprotected fields. His fence was built separating a woodland from a strip of Bermuda grass on which later white clover and Dallis grass had been sown. More recently a new fence was built along the line of the old fence. The old fence posts now stand only 18 inches above the present soil level. That is, in 9 years soil carried from slopes of unprotected cultivated fields has been held and deposited along this fence row to a depth of 4½ feet. This same effect is observed under wind-erosion conditions.

Mr. Neill has 30 acres in pasture, 20 acres of which are new, but thriving and serving in the erosion control plan.

RESERVOIR SILTING RESULTS FROM PREVENTABLE EROSION, SURVEY SHOWS

Mud cracks on drying silt surface exposed by lake drawdown. Background shows the great width and depth of mud fill. Roosevelt Reservoir, Salt River, Ariz.

A progress report on reservoir surveys and investigations has been prepared by Henry M. Eakin, in charge of sedimentation studies.

It was because of the inherent relation of silting of reservoirs to problems of erosion control that the Soil Conservation Service inaugurated, in July 1934, an attempt at a general Nation-wide survey of the conditions of reservoirs with respect to reduction of storage by silting.

The ultimate objective is to establish information on the factors involved in the silting of reservoirs, the rates of silting, soil slope and climate conditions, and to correlate these with land use in watershed areas. Such a broad factual basis appears necessary to the sound determination of policy and practice of reservoir development and silt control.

Detailed Surveys Made

The work thus far done consists of detailed surveys of silt accumulations in representative reservoirs in the Southeastern, the South Central and the Southwestern areas, together with reconnaissance examinations of other reservoirs in the same territories incident to selection of more broadly significant cases for special study.

The direct purpose of each survey has been to determine the volume and distribution of sediment deposits accumulated in the reservoir during a known period of time, either the entire period of the reservoir's existence or a shorter period between an earlier survey and the current resurvey. From these data and the area of watershed, the average rate of silting per year per unit of drainage area is derived. This constitutes perhaps the most practical index to differences and changes in regional erosional conditions and expectancy of useful life of existing or contemplated reservoirs.

The following table is indicative of the magnitude of the silting problem as revealed in this preliminary report:

RESERVOIRS SURVEYED BY SOIL CONSERVATION SERVICE, 1934–35

Name	Location	Period	Years	Original capacity	Storage per square mile of drainage area	Annual silt accumulation per 100 square miles of drainage area	Annual depletion of storage	Total depletion of storage to date of survey
				Acre-feet	*Acre-feet*		*Percent*	*Percent*
Lake Michie	Durham, N. C.	April 1926–January 1935	8.75	13,457	79.16	27.69	0.35	3.07
University Lake	Chapel Hill, N. C.	June 1932–April 1935	2.92	2,076	76.92	87.90	1.13	3.29
Greensboro Reservoir	Greensboro, N. C.	February 1923–August 1934	11.50	2,870	39.80	31.30	.78	9.05
High Point Reservoir	High Point, N. C.	August 1927–August 1934	7.00	4,220	72.00	60.80	.84	5.87
Lake Concord	Concord, N. C.	March 1925–May 1935	10.16	1,179	310.49	200.80	.65	6.57
Spartanburg Reservoir	Spartanburg, S. C.	May 1926–July 1934	8.17	2,700	29.30	62.00	2.10	17.13
Lloyd Shoals Reservoir (Ocmulgee River)	Jackson, Ga.	December 1910–March 1935	20.33	107,702	78.24	26.30	.56	14.58
Rogers Reservoir	Rogers, Tex.	September 1922–September 1934	12.00	164	300.00	568.00	1.90	23.00
Lake Waco	Waco, Tex.	April 1930–March 1935	5.00	42,223	25.41	61.78	2.43	12.16
White Rock Reservoir	Dallas, Tex.	1910–1935	25.00	19,540	171.41	140.83	.82	20.54
Guthrie Reservoir	Guthrie, Okla.	October 1920–May 1935	14.50	3,232	243.03	234.81	.97	4.01
Boomer Lake	Stillwater, Okla.	March 1925–June 1935	10.25	2,794	306.11	182.01	.59	6.45
Elephant Butte Reservoir (Rio Grande River)	Hot Spring, N. Mex.	January 1915–April 1935	20.25	2,638,860	100.29	76.97	.76	15.50
San Carlos Reservoir (Gila River)	Coolidge Dam, Ariz.	October 1928–February 1935	6.33	1,247,999	92.15	43.05	.46	2.93

The data already in hand impel Mr. Eakin to conclude that the silting of reservoirs is a practical problem of the first order in all three regions, wherever accelerated erosion takes place.

Man Is Responsible

Observations made on the many other reservoirs visited but not yet surveyed, and on erosional conditions along all routes of travel emphasize the dependence of undue rates of silting upon man-induced erosion, he says.

In the Southeast, reservoir silting relates chiefly to erosion of deep residual soils as influenced by human occupation, the studies indicate. Lower rates were found to obtain in mountainous and other regions wherever the natural forest cover is practically intact. Higher rates are concomitant with poor agricultural practices in the lower Piedmont country. The report suggests the organized cooperation of the agricultural population toward better terrace and crop practices, structural and vegetational gully control, and the rededication of oversteep lands to noncultivated crops or forest growths.

Overgrazing Noted

In the Southern Great Plains higher rates of silting relate to erosion of sedimentary soils under defective agricultural and grazing practices. The surveys point to a need for greater attention to terracing and contour cultivation, to cover and strip cropping, and to the control of incipient gullies. In many places more restricted grazing and the restoration of the ranges are needed. Silt detention above reservoir level in broad tributary valleys in most reservoir watersheds could be effectively and profitably employed, it is stated.

In the Southwest, the survey makes plain, higher rates of silting are largely the result of overgrazing and its consequence of extraordinary sheet and gully erosion. Sheet erosion, perhaps, can be reduced in time through further restriction of grazing. Sediment from formation of arroyos and gullies can be reduced or largely prevented by engineering or vegetative methods. Silt detention above reservoir level in broad tributary valleys, by earth barriers, and by growth of vegetative screens, is highly practicable in many cases.

Selective Waste

It would also appear, in view of the indications of underflow and congregation against the dams in this region of muddy flood flow waters, that important reduction of rate of silting would be feasible by selective waste of heaviest-charged waters through low-placed outlet gates. Such waters remain fluid after considerable settling and concentration of mud charge, and are capable of selective movement toward a lower outlet. Under laws of stratification of liquids of different densities, sludges carrying 20 to perhaps 30 percent of solid matter should be subject to such selective movement for long distances above dams. This presupposes that selective evacuation be practiced from the start to maintain the bottom slope and

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The efficiency of this reservoir at Spartanburg, S. C., has been practically ruined due to the collection of silt and clay above the dam. Only the stream channel is open.

NURSERY PROGRAM UNIFIED IN INTEREST OF EFFICIENCY

To furnish camps and projects the planting materials necessary for a broad soil-conservation program is the function of 80-odd nurseries now set up or in process of being started.

Until now the development of nursery activities in the Soil Conservation Service has been largely spontaneous and more or less haphazard.

In August 1933 the Bureau of Plant Industry was given a grant for the establishment of erosion-control nurseries. These have operated partly as quantity-production units and partly on an experimental basis for assembling and propagating better materials than are now available in commercial, large-scale forestry operations.

A number of S. C. S.-E. C. W. camps initiated nurseries while they were under the supervision of Forest Service or other agencies. Mostly, they confined themselves to the growing of black locust.

Project Nurseries Started

Some of the original S. C. S. projects saw the need of starting nurseries to provide their own planting materials, financing them out of their own funds. As E. C. W. labor became available these nurseries have gradually been merged with the E. C. W. program.

In some instances cooperative agreements have been worked out with State forestry departments. The Service has at times provided equipment enabling State foresters to grow and turn over to it all needed materials without the necessity of any supervision on its part. At other times the Service has made definite growing contracts at fixed figures, with the State providing labor, seed, supervision, and land. In still other cases the Service has been able to purchase planting stock from State nurseries without preliminary arrangements.

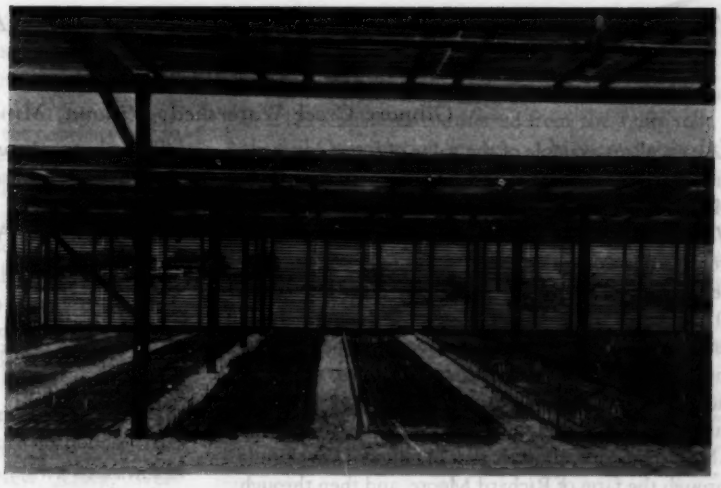
Unique Arrangement

A unique arrangement has prevailed in Nebraska and South Dakota, where the United States Shelterbelt project has handled most of the details. There rental agreements have been entered into with commercial nurserymen for the use not only of land but also of facilities, tools, irrigation systems, packing sheds—in fact, everything except seed, supervision, and unskilled labor.

Finally, large numbers of trees have been purchased outright from private nurseries.

In view of the diversified needs of the 140 projects and 500 erosion camps, such a heterogeneous collection

Plots on which grasses are being transplanted, showing irrigation ditch in foreground.



Lath-house constructed at the Tucson, Ariz., nursery to propagate promising native and introduced erosion-control plants.

of nurseries may appear entirely in order. There are a number of very good reasons, however, to account for the centralization of nursery responsibility which has just been effected.

In the first place, projects have not been supplied with the planting materials they should have. It has been impossible to make arrangements for such materials until the project was well under way. In some States delays ensued and elsewhere the increased program has moved much faster than any possible nursery expansion.

It is important not only that suitable planting materials be available to the Service, but that they be grown where and how they ought to be, and that they be forthcoming when needed.

A further complicating factor has been the inability of any region to plan on a reserve supply to care for possible calamities. In this connection it should be recalled that the Zanesville, Ohio, project lost approximately 24 million trees in one flood. It can reasonably be expected that over a period of years disasters of this sort—floods, hailstorms, droughts, insect or disease epidemics—will be pretty sure to occur. It is only through a national, unified program that provision can be made for such emergencies. Through the planting of a small reserve in each nursery movement can be made toward a region which has lost its planting stock.

Only through a centralized program such as the Service is now initiating, can efficient nursery projects be maintained. A list of 80 nurseries may be too many, even for a service as extensive as ours. There is a certain minimum of size below which it is not at all feasible to operate a nursery. Trained personnel, suitable nursery equipment, long-time leases on land, and other factors make it highly undesirable to operate small units. On the other hand, there are limits as to how big a nursery should be in addition to the very practical one of growing materials as near to the place where they will be used as practicable.

Use of Black Locust

Due to the emergency nature of our program, it has been necessary in the past to use far more black locust than is ordinarily desirable. Most foresters and entomologists agree that the hundreds of millions of black locust that have been planted in almost pure stand are certain to bring on a serious infestation of the locust borer. The answer to this problem lies in mixed plantings in which black locust will constitute, at most, little more than 20 percent. The planning of such a variation in materials lies within the province of woodland management rather than of the nursery division. It is, however, only through centralization of nursery work that a better choice of materials can be obtained than that which has been used the past 2 years.

Throughout a large part of the country conifers are our preference. To indulge this choice, it is necessary

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ONE STREAM AND TWO FARMS

By A. F. Laidlaw

Gilmore Creek Watershed, Winona, Minn.

An excellent example of the value of forest cover on critical slopes exists on the farm of one whom we shall call Edward Jackson, in the Gilmore Valley area, near Winona, Minn., which is a part of the Root River project, no. 26. There are several slopes in this area as high as 70 percent with many between 40 and 60 percent. With such excessive slopes, the maintenance of an adequate forest cover becomes doubly important. Mr. Jackson has realized that not only the slopes, but the gullies and stream banks as well, must be kept covered with vegetation.

Near its mouth, the east fork of Gilmore Creek runs through the farm of Richard Moore, and then through that of Mr. Jackson. The line fence between the two farms crosses the creek about a quarter of a mile above the mouth of the fork. The downstream part of this creek lies entirely on Mr. Jackson's farm. Above the fence, the creek extends on up the valley across the adjacent farm. The fence represents a great deal more than a property boundary.

On the downstream side of the fence, the stream bank has not been grazed. It now bears a dense growth of cottonwoods and willows. This vegetation has very effectively held the width of the channel to a minimum, and the banks are low and sloping. On the other side, cattle have grazed to the very edge of the banks. Here the creek is much wider and the banks are not covered with soil-holding vegetation; instead, they are raw, open cuts which yearly dump great loads of silt into the freshets. This soil could be held in place by an ample protection of trees. The channel is from 2 to 3 feet deeper here and from 16 to 30 feet wider than where the banks are covered with trees.

The following table gives some indication of the value of the cover on the downstream farm:

Station	Width	Depth
Upstream:		
300 feet	43 feet	5 feet.
200 feet	40 feet	4 feet 6 inches.
100 feet	66 feet	10 foot cut.
At line fence	55 feet	6 foot cut.
Downstream:		
100 feet	26 feet	3 foot cut.
200 feet	19 feet	2 foot cut.
300 feet	18 feet	2 foot cut.

These figures show clearly what an ample vegetative cover will do toward holding an erosive stream bank in place.

Not Always Protected

At one time this downstream farm also had no cover along the banks, as one can clearly see where the old banks were located before the trees grew. This farmer however, realized the value of trees for stream-bank protection and has refused to permit grazing along the banks, thus giving the trees a chance. Along one small section of bank, the trees have been undercut and washed away. Here bank cutting is developing and will continue if not checked. Trees have not been planted to hold the soil in place.

About one-eighth mile above the mouth of this fork, the creek receives water drained from an area of approximately 25 acres. This water, concentrated in one large gully one-half mile long, has brought down a considerable number of rocks and silt. Cutting across a valuable hay meadow has been checked by permitting a large ungrazed area of woods to grow up on the fan at the mouth of the gully. This means that the lower part of the creek carries a larger volume than the upper and hence is more susceptible to cutting.

Thus, Mr. Jackson has demonstrated clearly the value of soil-holding vegetation on his farm. He has maintained his meadow in a workable condition at no outlay of expense to himself, whereas it would have taken much time and labor with lower resultant returns had the stream-bank cutting and gullying been allowed to continue.

SIX PRACTICAL POINTERS

Results of erosion control experiments on Cecil clay loam are summarized by the agricultural engineering department of the Alabama Experiment Station, as follows:

(1) Terraces, while often indicated on steep cultivated land to prevent gullying, alone do not sufficiently control erosion.

(2) Austrian peas or vetch will satisfactorily control erosion once they cover the ground.

(3) The losses from a single rain of material carrying plant food may be more than that supplied by a winter cover crop, if the land is left unprotected during the cultivation period.

(4) Planting in strips eliminates the necessity of having all the field plowed up or loose at the same time.

(5) "Filter" cropping (use of close growing crops) reduces sheet erosion between terraces very materially.

(6) Certain leguminous crops used as filter crops are satisfactory in preventing erosion.

SEVERAL REGIONS ESTABLISHED

In accordance with plans in formulation for some time, the following regions have been designated:

Region 1, northeast region.—New Jersey, West Virginia, Pennsylvania, Maryland, Rhode Island, Delaware, New York, Connecticut, Massachusetts, Vermont, New Hampshire, and Maine. Headquarters, Indiana, Pa.; regional conservator, A. L. Patrick.

Region 2, southeast region.—Florida, Virginia, North Carolina, South Carolina, Georgia, Alabama, and Mississippi. Headquarters tentatively located at Spartanburg, S. C.; regional conservator, Dr. T. S. Buie.

Region 4.—Arkansas, Louisiana, and Texas, except that portion of the western Texas Panhandle to be included in region 6. Headquarters to be announced later; regional conservator, L. P. Merrill.

Region 8, southwest region.—New Mexico, Arizona, Utah, and Colorado, and that portion of the Virgin River watershed lying in the State of Nevada. Headquarters, Albuquerque, N. Mex.; regional conservator, Hugh G. Calkins.

While it is planned ultimately to decentralize many functions from the Washington office to the regional office, it is anticipated that these changes will require some time to put into effect. Approval of such decentralization will be made as rapidly as adequate machinery can be set up in the regional office.

Natural cover of forest and grass will absorb rain water as it falls and protect the soil from erosion, but when the natural coverage is destroyed and no methods are used for controlling the rainfall, the rapid run-off water results in erosion.

PROGRESS IN EMPLOYMENT OF RELIEF LABOR

The most recent weekly report showed an increase of 2,172 employees transferred from the relief rolls to the Soil Conservation Service. On one watershed the relief-labor quota had been exceeded by more than 56 percent. On another the local Service requirements had absorbed all available labor of a relief classification. Throughout the country, projects are making an intensive effort to cooperate in the works program by meeting their assigned quotas.

Following is a statistical summary, as of September 21:

State or watershed	Number of relief workers	Relief quota	Regional director	Percentage of relief labor quota
South Carolina	1,210	775	Buie	156.1
Colorado	617	772	McClymonds	79.9
New York	329	420	Howe	78.3
New Jersey	202	268	Lee	73.4
Pennsylvania, Maine	447	605	Patrick	73.9
Virginia	211	347	Keil	60.8
Wisconsin, Minnesota	256	431	Davis	59.6
Nebraska	124	214	vonTrebra	57.9
Georgia	409	795	Rast	51.4
East Texas	221	450	Merrill	49.1
California, Nevada	446	931	Reddick	48.0
Illinois	158	337	Fisher	46.9
Central Texas	300	647	Geib	46.4
Navajo	565	1,306	Matthews	43.3
North Carolina	540	1,354	Stallings	39.9
Alabama, Florida	233	606	Bailey	38.4
Mississippi	272	758	Anders	35.9
Kansas	156	445	Duley	35.1
South Dakota, North Dakota, Montana	270	790	Clemmer	34.2
Iowa, Missouri	T378	1,123	Uhland	33.7
Ohio, West Virginia, Indiana, Michigan	T337	1,052	Cutler	32.0
Gila	358	1,400	Fleming	25.6
Louisiana	156	688	Mims	22.7
Oregon, Idaho, Washington	94	425	Rockie	22.1
North Texas	69	576	Finnell	12.0
Kentucky	35	314	Alberts	11.1
Arkansas	91	888	Sargent	10.2
Rio Grande	65	1,040	Smith	6.3
Oklahoma	52	1,051	Winters	4.9
Wyoming	3	370	McClymonds	.9
Maryland	0	185	Bruce	0
Utah	.....	162	.....	.....
Total	8,604	21,552	Average	39.9
BY REGIONS				
1. Northeast region, no. 1 (Pennsylvania, Maryland, Rhode Island, New Jersey, Delaware, New York, Connecticut, Massachusetts, Vermont, New Hampshire, Maine.)	978	1,478	Patrick	66.2
2. Southeast region, no. 2 (Virginia, North Carolina, South Carolina, Georgia, Alabama, Florida, Mississippi.)	2,875	4,635	Buie	62.0
3. Southwest region, no. 8 (Colorado, Wyoming, Utah, Arizona, New Mexico (latter 2 include Navajo, Gila, and Rio Grande Watersheds).)	1,608	5,029	Calkins	32.0

A GILA RIVER GONE BERSERK

By E. Edgar Fuller

President Gila Junior College, Thatcher, Ariz.

Bank cutting on the Gila River in July 1934. This picture and its companion were taken a few minutes apart.

On April 8, 1879, Hyrum Weech arrived in the Gila Valley to make his home. It is difficult for one who lives in that valley at the present time to believe that the view which greeted him was so totally unlike that which one sees there today. Yet scores of old residents tell the same story about the condition of those days, so graphically related in the autobiography of this remarkable pioneer:

> The river, winding its course through the valley, was fringed on both sides with cottonwood and willow trees. The valley was covered with groves of mesquite trees and stretches of open ground covered with grass. The Gila then was a stream with well-defined banks and sloping, graveled bottom. It was about 4 to 6 rods wide.

Today, instead of a quiet, clear stream less than a hundred feet across there is a winding channel on the average of more than 2,000 feet wide. Scores of farms have been washed away and the river channel occupies more than 16,000 acres of once rich farm land. The water rushes down in muddy torrents after each rain, carrying vast quantities of silt into the great San Carlos Reservoir.

The once-thick growth of mesquite and other trees has been so completely cleared away that firewood now has to be hauled from the mountains. With the clearing of the land the river has cut farther and farther back into the farm lands. Today it occupies about one-third of all the arable land of the valley. Some of this can be reclaimed, and many of the dangers of future damage can be avoided by a program of soil conservation, but much has been lost forever.

What is true of the river is equally true of the small tributaries. Many of these runs and gullies have become veritable canyons due to overgrazing and removal of vegetation along their banks. One of the most spectacular and tragic examples is the San Simon wash, a chasm more than 60 miles long which is in many places hundreds of feet wide and between 20 and 30 feet deep.

The true story of the San Simon is almost unbelievable. Fifty years ago there was a great unbroken meadow from Rodeo to Solomonsville. Drainage was well spread over the area and each heavy rain replenished the artesian wells and water holes without a

rapid run-off. Nevertheless, the most severe storms deposited some debris upon the lands of a few farmers living near Solomonsville and they excavated a channel about 20 feet wide and 4 feet deep for a short distance to aid the drainage into the Gila. A few funneling levees and furrows to help the drainage into the main channel completed this part of the work. Consistent over-grazing and occasional droughts and heavy rains did the rest.

A Destruction That Never Pauses

An empire of 1,250,000 acres, stretching from the 21,000 acres of timber on the upper end of the watershed through a succession of grassy plains to the fine agricultural land of the lower areas, has already been partially destroyed. Thousands of acre-feet of silt have been washed into the Gila and thence to the reservoir below. The wash grows larger year by year.

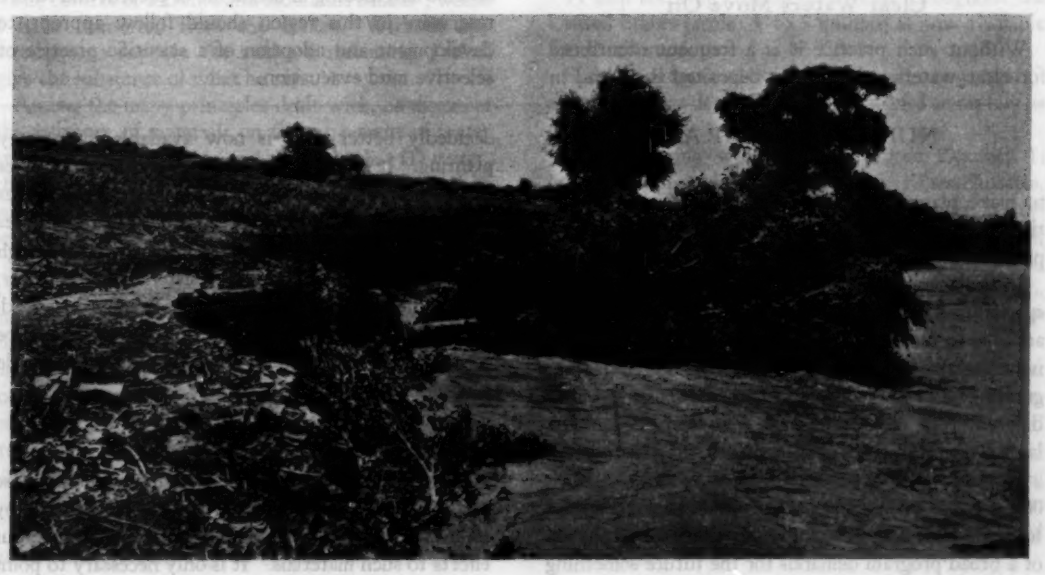
Such instances as these might easily be multiplied because practically every wash tributary to the Gila tells the same history. The young children of Hyrum Weech, in the early days of the settlement of Pima, ate their picnic lunches on the banks of Cottonwood wash. It was a tree-bordered creek only a few feet wide. It is now a deep dry wash similar to the San Simon, more difficult to control each year.

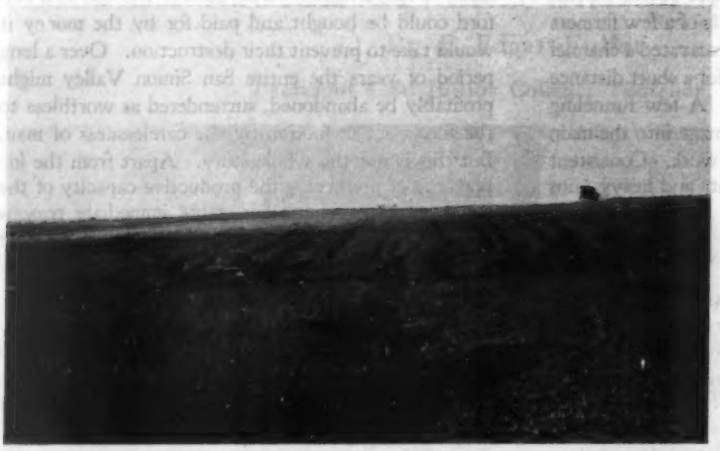
The actual destruction of the land is only one phase of the problem of the watershed. Perhaps the 40,000 acres of rich irrigated farms around Duncan and Safford could be bought and paid for by the money it would take to prevent their destruction. Over a long period of years the entire San Simon Valley might profitably be abandoned, surrendered as worthless to the forces set in motion by the carelessness of man. But this is not the whole story. Apart from the importance of preserving the productive capacity of the soil for future generations, more immediate reasons make it imperative that everything possible be done to control erosion and floods on the Gila.

Menace to Coolidge Dam

Continued erosion along the upper Gila River will doom the Coolidge Dam and the lands below it. Already the cost of removing silt from the distributaries of the San Carlos project is more than $100,000 each year. Without erosion control the life of this project will undoubtedly be made shorter by many years. The welfare of the upper valley is in this matter the welfare of all who use the waters of the Gila.

The soil-conservation program goes to the heart of the problem. Instead of ruined and abandoned lands, there is a vision of the future that includes the best that Hyrum Weech saw when he gazed on a virgin valley in 1879. Rebuilding of soil, the planting of trees and grass, and an adequate and steady supply of water are among the objectives.





Characteristic erosion of black lands, Rogers, Tex. Gullies are developing where plough rows run with the slope.

RESERVOIR SILTING

(Continued from page 7)

a deep sludge pocket approaching the dam. Silt deposits against the dam and in adjacent deeps reduce the force of selective flow and the thickness of muddy water accumulation at the dam. They thus preclude the possibility of deferred development of optimum mud-evacuation practice.

Clear Waters Move On

Without such practice it is a frequent occurrence for clear waters, which have deposited their load in the reservoir to be wasted over the spillway, to make room at the bottom for a new body of very muddy water. This would appear to be the worst possible arrangement for shortening reservoir life. On the other hand, since the predominant volume of solid matter that encroaches upon capacity of these Southwestern reservoirs is composed of finer grained silts and clays, long held in suspension before final settlement and semisolidification, it appears that a very notable lengthening of useful life of present and future reservoirs in this region should follow appropriate development and adoption of a scientific practice of selective mud evacuation.

NURSERY PROGRAM

(Continued from page 9)

to make plans for several years ahead, inasmuch as this kind of stock must be at least 2 years old, and preferably 3.

Miscellaneous shrubs for game cover, and other special plants, in addition to assisting erosion control, are able to furnish something of use to the farmer. It is necessary that the nurserymen who are collecting, growing, and testing such materials have quite a different type of training from that demanded in the large-scale production of black locust.

It is true that the Service, in planting some 400,000,000 or 500,000,000 trees per year must stick very close to proved species. On the other hand the execution of a broad program demands for the future something decidedly better than is now available in forestry planting. It is only necessary to cite known examples such as hybrid-walnut trees, which produce 20 times the amount of growth that ordinary walnut trees produce, honey locust yielding 2-foot pods of high sugar content, black locust resistant to the borer, native plums much better than miscellaneous seedlings, to indicate that we should by no means be content with materials now available for large-scale production.

Testing on Large Scale

Likewise, although the use of plant materials close to the place of origin is a good general practice, it by no means follows that we must or should confine our efforts to such materials. It is only necessary to point

to present-day agronomy and horticulture to see that almost without exception commercial crops reach their highest stage of perfection several hundred or even several thousand miles from the place of origin. This does not imply that without trial we should move materials long distances and plant on ordinary cooperating farms large numbers of materials which have not been tried in the vicinity. It does suggest, however, a large amount of moving about and testing of small lots.

Specifically, it is planned that a few nurseries shall be especially occupied with assembling, propagating and testing relatively large numbers of species of plants. This list includes Fairhope, Ala.; Chapel Hill, N. C.; Zanesville, Ohio; Elsberry, Mo.; Ames, Iowa; Tucson, Ariz.; Pullman, Wash.; Mandan, N. Dak.; Lincoln, Nebr.; Stillwater, Okla.; Albuquerque, N. Mex., and Winona, Minn.

IS CLEAR WATER MORE EROSIVE?

SISTEMAZIONE DEI TORRENTI E DEI BACINI MONTANI, by Carlo Valentini. Ulrico Hoepli, editor, Milano, Italy, 1930. 20 lire. Translated from the Italian by Albert Chiera.

Mr. Valentini, who is the author of several technical volumes, has written a very interesting book on "The control of torrents and mountain basins", which I have translated from the Italian. Without any attempts to support the author's reasoning, I shall give the substance of what he says.

Among the many principles dealt with, he discusses the influence of materials on the movement of water and proves by equations and diagrams that (1) water, charged with materials, moves more slowly than water free from them and, (2) that clear water possesses a greater erosive power.

These two principles as set forth by the author have a bearing on the difficulties encountered in controlling mountain torrents. Since, in the usual procedure, to manage an unruly stream the engineer starts from the premise that, by regulating a water course, the velocity is reduced so that deposits take place, he may underestimate the fact that the water released from its burden becomes clearer and, therefore, more erosive, and that its velocity increases in proportion.

The author's arguments are as follows:

Let us assume that a stream loaded with material runs in a channel at a given velocity, and due to this velocity the material is held in suspension. Let us assume, also, that for some reason or other the stream reaches a broad stretch over which it is forced to spread. Naturally, its velocity decreases, and the material held in suspension is immediately deposited. The stream at this point, having unloaded itself of the burden, becomes clear and assumes, consequently, a greater velocity. Becoming, therefore, more erosive, it begins instantly to scour down the bed and to lift material of the size corresponding to its newly acquired velocity, and after having reached a certain point of saturation proceeds to carry the material and to unload it again when its velocity may, for any reason, diminish.

The foregoing explanation is corroborated also by the examination of a diagram of a longitudinal profile of a stream which shows the theoretical ideal compensation slope and a profile prior to its regulation, wherein it is seen almost invariably that wherever a deposit of material occurs, an erosion immediately follows.—Albert Chiera.

EDITOR'S NOTE.—The energetics of debris-laden waters are currently being made the subject of experimental investigations by the Soil Conservation Service in cooperation with the California Institute of Technology, at Pasadena.

EROSION MAPS READY

A map showing erosion conditions throughout the United States (scale: 1 to 5 million) is now available for distribution.

State maps (scale: 1 to 500 thousand), showing conditions in more detail, are being prepared as rapidly as possible.

The following will be ready before October 1: Maine, Vermont, New Hampshire, Massachusetts, Connecticut, New York, Ohio, Pennsylvania, Maryland, Delaware, West Virginia, Kentucky, Virginia, Tennessee, North Carolina, South Carolina, Florida, Louisiana, North Dakota, Minnesota, Michigan, Iowa, Illinois, Kansas, Oklahoma, Arkansas, Mississippi, Alabama.

Obtainable after October 15: Missouri, Georgia, Indiana, South Dakota, Nebraska, Wisconsin, Texas.

Ready December 1: Washington, Oregon, and California.

For one reason or another maps for the following States will not soon be available: Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico.

CONTOUR FURROWS, GRASS UP, FIRM AND UNIFORM

Typical of the specialized machinery which is being developed to assist the work of conserving the Nation's soils is the ingenious device at the left, in use on the Mankato, Kans., project. A U-knife slices a furrow some 4 inches deep; curved rods guide the severed strip upward and to the side where the sod is neatly deposited grass side up. A roller then packs it firmly in place.

Since this picture was made, the roller has been improved by having its surface made somewhat concave so that the pressure will be greater at the edges. Various other improvements are in an experimental stage.

The results of using this machine are shown in the lower view, the serpentine contour furrows serving notice that here is a pasture where run-off will in the future be restrained.

Contour furrows conserve moisture, help to develop more permanent pastures, keep seed from washing away, promote a greater variety of vegetation.